

What is claimed is:

1. Data storage logic for controlling a magnetic tape drive for storing data on a magnetic tape data storage media in a plurality of wraps, which comprise a plurality of parallel longitudinally recorded tracks, said magnetic tape drive having at least one input and/or output, having at least one data buffer, and having a plurality of stepped operational speeds for moving said magnetic tape data storage media longitudinally with respect to at least one tape head for transferring data by reading and/or writing data with respect to said magnetic tape data storage media, said magnetic tape drive capable of conducting a backhitch of said magnetic tape data storage media, said data storage logic:

10 estimates the effective data fill and/or empty rate for said at least one data buffer with respect to said input and/or said output;

estimates the drive data rate for transferring data with respect to said at least one data buffer and said magnetic tape data storage media at the current stepped operational speed of said magnetic tape drive;

15 estimates, from said effective data fill and/or empty rate for said at least one data buffer and said drive data rate, the time cost to continue to operate said magnetic tape drive at said current stepped operational speed from a target to substantially the next end of wrap;

estimates, from said effective data fill and/or empty rate for said at least one data buffer and a data rate for transferring data with respect to said magnetic tape data storage media of at

20 least one higher stepped operational speed of said magnetic tape drive, together with a forced backhitch of said magnetic tape drive, the time cost to force a backhitch of said magnetic tape

data storage media and change said stepped operational speed to said higher stepped operational speed and to operate said magnetic tape drive at said higher stepped operational speed from said target to substantially the next end of wrap; and

determines the lesser of said time costs.

5 2. The data storage logic of Claim 1, additionally:

monitors a threshold between said time cost of said current stepped operational speed; and a lesser time cost to force said backhitch of said magnetic tape data storage media and change said stepped operational speed to said higher stepped operational speed; and

if said threshold is met and/or exceeded, selects said determined lesser time cost which  
10 comprises forcing said backhitch of said magnetic tape data storage media and changing said stepped operational speed to said higher stepped operational speed; and

if said threshold is unmet and/or unexceeded selects said current stepped operational speed without regard to which estimated time cost comprises said lesser of said estimated time costs.

3. The data storage logic of Claim 2, wherein said threshold comprises a predetermined count; and wherein said data storage logic conducts said time cost estimates on a periodic basis and wherein said count is incremented at each successive instance that said periodic time cost estimates determines said lesser one of said time costs is said time cost to force said backhitch of  
5 said magnetic tape data storage media and change said stepped operational speed; and said count is reset upon forcing said backhitch.

4. The data storage logic of Claim 2, additionally:  
if said determined lesser time cost comprises said at least one higher stepped operational speed, and said higher stepped operational speed is selected, controlling a threshold of said buffer  
10 to establish the timing of said backhitch.

5. The data storage logic of Claim 1, additionally comprising determining the distance to an end of wrap, and, if said distance to an end of wrap is less than a predetermined distance, preventing a backhitch.

6. The data storage logic of Claim 1, additionally comprising determining two said stepped  
15 operational speeds bounding said estimated effective data fill and/or empty rate for said at least one data buffer; and performing said lesser time cost determination with respect to said two operational speeds and said current operational speed.

7. A recording system for a magnetic tape drive for storing data on a magnetic tape data storage media in a plurality of wraps, which comprise a plurality of parallel longitudinally recorded tracks, said magnetic tape drive having at least one input and/or output, having at least one tape head for transferring data by reading and/or writing data with respect to magnetic tape data storage media, and a drive system for moving said magnetic tape data storage media longitudinally with respect to said at least one tape head, said drive system having a plurality of stepped operational speeds, said magnetic tape drive capable of conducting a backhitch of said magnetic tape data storage media, said recording system comprising:

at least one data buffer; and

data storage logic:

estimates the effective data fill and/or empty rate for said at least one data buffer with respect to said at least one input and/or output;

estimates the drive data rate for transferring data with respect to said at least one data buffer and said magnetic tape data storage media at the current stepped operational speed of said drive system;

estimates, from said effective data fill and/or empty rate for said at least one data buffer and said drive data rate, the time cost to continue to operate said drive system at said current stepped operational speed from a target to substantially the next end of wrap;

estimates, from said effective data fill and/or empty rate for said at least one data buffer and a data rate for transferring data with respect to said magnetic tape data storage media of at least one higher stepped operational speed of said drive system, together with a forced backhitch of said drive system, the time cost to force a backhitch of said

magnetic tape data storage media and change said stepped operational speed to said higher stepped operational speed and to operate said drive system at said higher stepped operational speed from said target substantially to the next end of wrap; and determines the lesser of said time costs.

- 5 8. The recording system of Claim 7, wherein said data storage logic additionally:  
monitors a threshold between said time cost of said current stepped operational speed;  
and a lesser time cost to force said backhitch of said magnetic tape data storage media and  
change said stepped operational speed to said higher stepped operational speed; and  
if said threshold is met and/or exceeded, operates said drive system to force said  
10 backhitch of said magnetic tape data storage media and change said stepped operational speed to  
said higher stepped operational speed; and  
if said threshold is unmet and/or unexceeded, said data storage logic selects said current  
stepped operational speed of said drive system without regard to which estimated time cost  
comprises said lesser of said estimated time costs.

- 15 9. The recording system of Claim 8, wherein said threshold comprises a predetermined  
count; and wherein said data storage logic conducts said time cost estimates on a periodic basis  
and wherein said count is incremented at each successive instance that said periodic time cost  
estimates determines said lesser one of said time costs is said time cost to force said backhitch of  
said magnetic tape data storage media and change said stepped operational speed; and said count  
20 is reset upon forcing said backhitch.

10. The recording system of Claim 8, wherein said data storage logic additionally, if said determined lesser time cost comprises said at least one higher stepped operational speed, and said higher stepped operational speed is selected, controls a threshold of said buffer to establish the timing of said backhitch.

5 11. The recording system of Claim 7, wherein said data storage logic additionally determines the distance to an end of wrap, and, if said distance to an end of wrap is less than a predetermined distance, prevents a backhitch.

12. The recording system of Claim 7, wherein said data storage logic additionally determines two said stepped operational speeds bounding said estimated effective data fill and/or empty rate  
10 for said at least one data buffer; and performs said lesser time cost determination with respect to said two operational speeds and said current operational speed.

13. A magnetic tape drive for storing data on a magnetic tape data storage media in a plurality of wraps, which comprise a plurality of parallel longitudinally recorded tracks, comprising:

at least one input and/or output;

at least one tape head for transferring data by reading and/or writing data with respect to

5 magnetic tape data storage media;

a drive system for moving said magnetic tape data storage media longitudinally with respect to said at least one tape head, said drive system having a plurality of stepped operational speeds, said magnetic tape drive capable of conducting a backhitch of said magnetic tape data storage media;

10 at least one data buffer; and

data storage logic:

estimates the effective data fill and/or empty rate for said at least one data buffer with respect to said at least one input and/or output;

estimates the drive data rate for transferring data with respect to said at least one  
15 data buffer and said magnetic tape data storage media at the current stepped operational speed of said drive system;

estimates, from said effective data fill and/or empty rate for said at least one data buffer and said drive data rate, the time cost to continue to operate said drive system at said current stepped operational speed from a target to substantially the next end of wrap;

20 estimates, from said effective data fill and/or empty rate for said at least one data buffer and a data rate for transferring data with respect to said magnetic tape data storage media of at least one higher stepped operational speed of said drive system, together with

a forced backhitch of said drive system, the time cost to force a backhitch of said magnetic tape data storage media and change said stepped operational speed to said higher stepped operational speed and operate said drive system at said higher stepped operational speed from said target to substantially the next end of wrap; and

5 determines the lesser of said time costs.

14. The magnetic tape drive of Claim 13, wherein said data storage logic additionally:  
monitors a threshold between said time cost of said current stepped operational speed;  
and a lesser time cost to force said backhitch of said magnetic tape data storage media and  
change said stepped operational speed to said higher stepped operational speed; and

10 if said threshold is met and/or exceeded, operates said drive system to force said  
backhitch of said magnetic tape data storage media and change said stepped operational speed to  
said higher stepped operational speed; and

if said threshold is unmet and/or unexceeded, said data storage logic selects said current  
stepped operational speed of said drive system without regard to which estimated time cost

15 comprises said lesser of said estimated time costs.



15. The magnetic tape drive of Claim 14, wherein said threshold comprises a predetermined count; and wherein said data storage logic conducts said time cost estimates on a periodic basis and wherein said count is incremented at each successive instance that said periodic time cost estimates determines said lesser one of said time costs is said time cost to force said backhitch of  
5 said magnetic tape data storage media and change said stepped operational speed; and said count is reset upon forcing said backhitch.

16. The magnetic tape drive of Claim 14, wherein said data storage logic additionally, if said determined lesser time cost comprises said at least one higher stepped operational speed, and said higher stepped operational speed is selected, controls a threshold of said buffer to establish the  
10 timing of said backhitch.

17. The magnetic tape drive of Claim 13, wherein said data storage logic additionally determines the distance to an end of wrap, and, if said distance to an end of wrap is less than a predetermined distance, prevents a backhitch.

18. The magnetic tape drive of Claim 13, wherein said data storage logic additionally  
15 determines two said stepped operational speeds bounding said estimated effective data fill and/or empty rate for said at least one data buffer; and performs said lesser time cost determination with respect to said two operational speeds and said current operational speed.

19. A method for operating a magnetic tape drive for storing data on a magnetic tape data storage media in a plurality of wraps, which comprise a plurality of parallel longitudinally recorded tracks, said magnetic tape drive having at least one input and/or output; having at least one tape head for transferring data by reading and/or writing data with respect to magnetic tape data storage media; having a drive system for moving said magnetic tape data storage media longitudinally with respect to said at least one tape head, said drive system having a plurality of stepped operational speeds, said magnetic tape drive capable of conducting a backhitch of said magnetic tape data storage media; and having at least one data buffer; comprising the steps of:

5       estimating the effective data fill and/or empty rate for said at least one data buffer with respect to said at least one input and/or output;

10       estimating the drive data rate for transferring data with respect to said at least one data buffer and said magnetic tape data storage media at the current stepped operational speed of said drive system;

      estimating, from said effective data fill and/or empty rate for said at least one data buffer and said drive data rate, the time cost to continue to operate said drive system at said current stepped operational speed from a target to substantially the next end of wrap;

15       estimating, from said effective data fill and/or empty rate for said at least one data buffer and a data rate for transferring data with respect to said magnetic tape data storage media of at least one higher stepped operational speed of said drive system, together with a forced backhitch

20       of said drive system, the time cost to force a backhitch of said magnetic tape data storage media and change said stepped operational speed to said higher stepped operational speed and to

operate said drive system at said higher stepped operational speed from said target to substantially the next end of wrap; and

determining the lesser of said time costs.

20. The method of Claim 19, additionally comprising the steps of:

5 monitoring a threshold between said time cost of said current stepped operational speed; and a lesser time cost to force said backhitch of said magnetic tape data storage media and change said stepped operational speed to said higher stepped operational speed; and

if said threshold is met and/or exceeded, forcing said backhitch of said magnetic tape data storage media and changing said stepped operational speed to said higher stepped operational

10 speed; and

if said threshold is unmet and/or unexceeded, selecting said current stepped operational speed of said drive system without regard to which estimated time cost comprises said lesser of said estimated time costs.

21. The method of Claim 20, wherein said threshold comprises a predetermined count; and

15 wherein said step of monitoring a threshold comprises conducting said time cost estimates on a periodic basis and incrementing said count at each successive instance that said periodic time cost estimates determines said lesser one of said time costs is said time cost to force said backhitch of said magnetic tape data storage media and change said stepped operational speed; and resetting said count upon forcing said backhitch.

22. The method of Claim 20, additionally comprising the step of:

if said determined lesser time cost comprises said at least one higher stepped operational speed, and said higher stepped operational speed is selected, controlling a threshold of said buffer to establish the timing of said backhitch.

5 23. The method of Claim 19, additionally comprising the steps of:

determining the distance to an end of wrap; and

if said distance to an end of wrap is less than a predetermined distance, preventing a backhitch.

24. The method of Claim 19, additionally comprising the step of determining two said

10 stepped operational speeds bounding said estimated effective data fill and/or empty rate for said at least one data buffer; and wherein said step of determining said lesser time cost comprises determining said lesser time cost with respect to said two operational speeds and said current operational speed.

25. A computer program product usable with at least one programmable computer processor having computer readable code embodied therein, said at least one programmable computer processor for controlling a magnetic tape drive for storing data on a magnetic tape data storage media in a plurality of wraps, which comprise a plurality of parallel longitudinally recorded  
5 tracks, said magnetic tape drive having at least one input and/or output, having at least one data buffer, and having a plurality of stepped operational speeds for moving magnetic tape data storage media longitudinally with respect to at least one tape head for transferring data by reading and/or writing data with respect to said magnetic tape data storage media, said magnetic tape drive capable of conducting a backhitch of said magnetic tape data storage media, said computer  
10 program product comprising:

computer readable program code causing said at least one programmable computer processor to estimate the effective data fill and/or empty rate for said at least one data buffer with respect to said at least one input and/or output;

computer readable program code causing said at least one programmable computer  
15 processor to estimate the drive data rate for transferring data with respect to said at least one data buffer and said magnetic tape data storage media at the current stepped operational speed of said magnetic tape drive;

computer readable program code causing said at least one programmable computer processor to estimate, from said effective data fill and/or empty rate for said at least one data  
20 buffer and said drive data rate, the time cost to continue to operate said magnetic tape drive at said current stepped operational speed from a target to substantially the next end of wrap;

computer readable program code causing said at least one programmable computer processor to estimate, from said effective data fill and/or empty rate for said at least one data buffer and a data rate for transferring data with respect to said magnetic tape data storage media of at least one higher stepped operational speed of said magnetic tape drive, together with a  
5 forced backhitch of said magnetic tape drive, the time cost to force a backhitch of said magnetic tape data storage media and change said stepped operational speed to said higher stepped operational speed and to operate said magnetic tape drive at said higher stepped operational speed from said target to substantially the next end of wrap; and

computer readable program code causing said at least one programmable computer  
10 processor to determine the lesser of said time costs.

26. The computer program product of Claim 25, additionally comprising:

computer readable program code causing said at least one programmable computer processor to monitor a threshold between said time cost of said current stepped operational speed; and a lesser time cost to force said backhitch of said magnetic tape data storage media and  
15 change said stepped operational speed to said higher stepped operational speed; and

computer readable program code causing said at least one programmable computer processor to, if said threshold is met and/or exceeded, select said determined lesser time cost which comprises forcing said backhitch of said magnetic tape data storage media and changing said stepped operational speed to said higher stepped operational speed; and

computer readable program code causing said at least one programmable computer processor to, if said threshold is unmet and/or unexceeded, select said current stepped operational speed without regard to which estimated time cost comprises said lesser of said estimated time costs.

5 27. The computer program product of Claim 26, wherein said threshold comprises a predetermined count; and wherein said computer program product additionally comprises computer readable program code causing said at least one programmable computer processor to conduct said time cost estimates on a periodic basis and increment said count at each successive instance that said periodic time cost estimates determines said lesser one of said time costs is said  
10 time cost to force said backhitch of said magnetic tape data storage media and change said stepped operational speed; and reset said count upon forcing said backhitch.

28. The computer program product of Claim 26, additionally comprising computer readable program code causing said at least one programmable computer processor to, if said determined lesser time cost comprises said at least one higher stepped operational speed, and said higher  
15 stepped operational speed is selected, control a threshold of said buffer to establish the timing of said backhitch.

29. The computer program product of Claim 25, additionally comprising computer readable program code causing said at least one programmable computer processor to determine the distance to an end of wrap, and, if said distance to an end of wrap is less than a predetermined distance, prevent a backhitch.

5 30. The computer program product of Claim 25, additionally comprising computer readable program code causing said at least one programmable computer processor to determine two said stepped operational speeds bounding said estimated effective data fill and/or empty rate for said at least one data buffer; and wherein said computer readable program code which causes said at  
10 least one programmable computer processor to determine said lesser time cost, causes said at least one programmable computer processor to determine said lesser time cost with respect to said two operational speeds and said current operational speed.